



# A history of the Universe

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**Study time: at least 60 minutes**

## Summary

This is an open-ended activity based around a multimedia package, which describes the important events in the evolution of the Universe from the very earliest times. The package contains animations, simulations and interviews with prominent astronomers and cosmologists.

The content of this package is of particular relevance to Chapters 6 and 8 of *An Introduction to Galaxies and Cosmology*.

## Learning outcomes

- Understand of the significance of key events in the history of the Universe.
- Appreciation of whether the physics of certain processes in the history of the Universe is speculative or well understood.
- Development of skills in locating information relevant to a particular topic.

## Background to the activity

This activity is somewhat different to the others that you have encountered in the course in that it is more open-ended. It is based around a multimedia package called 'A history of the Universe' which was originally developed for the course S103 *Discovering science*. The package has been updated for S282 and new sections have been added to cover some of the recent changes in cosmology. Even if you have studied S103, it is strongly recommended that you use this package to support your understanding of Chapters 6 and 8 of *An Introduction to Galaxies and Cosmology*.

Before using the package you should be aware of the following points.

Some of the numbers quoted in the package for times, temperatures and energies are slightly different to those quoted in *An Introduction to Galaxies and Cosmology*. In much of cosmology, only order of magnitude estimates can be made about physical conditions, and any differences between the course text and this package are insignificant.

The package has a little more detail about particle physics than is introduced in the main text. For instance, the package mentions hypothetical particles called X-bosons which are not discussed in *An Introduction to Galaxies and Cosmology*. These instances where the package goes beyond the main text should be considered as supplementary information – and not part of the core material that you would be expected to know about in S282.

# The activity

The following are some suggestions of how you might use ‘A history of the Universe’ package.

## 1 Prior to studying Chapter 6 of *An Introduction to Galaxies and Cosmology*

When you are ready to start studying Chapter 6 of *An Introduction to Galaxies and Cosmology*, it is recommended that you view the ‘Summary’ section of the package.

- To start the package:
- Start the S282 Multimedia guide, and open the folder called ‘Cosmology’, then click on the icon for A history of the Universe.
- Click Start.

The first time you open the package you should view an introductory section which gives details of how to find information in this package.

- Click on the button labelled Introduction.

You should then view the ‘Summary’ sequence as this will set the scene for Chapter 6.

- Click on Summary.

(Altogether this should take about 10–15 minutes.)

## 2 During your study of Chapter 6 of *An Introduction to Galaxies and Cosmology*

You can return to the package during your study of Chapter 6 to get more information, or a different perspective on many topics that are described in the text.

After opening the package, use the red planet-shaped slider on the right hand side of the screen to select a period in the history of the Universe. (The time is shown in the top centre part of the screen.)

For instance, if you want to know more about inflation, move the slider to about  $10^{-35}$  s. The word Inflation will appear on the main screen – click on this. The screen will then give you a choice of three topics about inflation

- What is inflation?
- What’s wrong with inflation?
- How does inflation gives rise to fluctuations?

So, by choosing the first of these topics, you will get the opportunity to view video clips in which five cosmologists (Alan Guth, Neil Turok, Jerry Ostriker, Andrew Liddle and Ed Copeland) give their explanation of what inflation is.

You will find that many of the topics covered in Chapter 6 of *An Introduction to Galaxies and Cosmology* are described in this package. Note also that the Search facility on the main screen of the package is another way to access descriptions of processes.

### **3      During your study of Chapter 8 of *An Introduction to Galaxies and Cosmology***

You will find that many of the more controversial areas of cosmology – which form some of the outstanding questions that are posed in Chapter 8 – are also discussed in this package. To return to the example discussed above, you might want to find out about some of the objections that cosmologists have to inflation. This is addressed in the section entitled ‘What’s wrong with inflation?’, in which Martin Rees, Neil Turok and Ed Copeland raise different issues that they see as problematic for this key idea in cosmology.

There are many interesting items in the package. For instance you can hear Neil Turok describing what are, for him, the key challenges in cosmology, or Jerry Ostriker’s views on the status of the anthropic principle.

### **4      As a resource of further information about galaxy formation and evolution**

Since the package covers the entire history of the Universe it also contains information about the formation of galaxies, and so can be used to revise some ideas that were introduced in Chapter 2 of *An Introduction to Galaxies and Cosmology*. In particular, there are some interesting video clips (under the heading ‘Galaxies evolve’) in which Roger Davies describes recent developments in the study of the evolution of galaxies.